Prepared in cooperation with the
United States Geological Survey
and the
Commissioners of Carroll County

INTRODUCTION AND MAP 1. SLOPE OF LAND SURFACE

Quadrangle Atlas No. 14

HYDROGEOLOGY

By James M. Weigle and others

INTRODUCTION

This atlas describes some aspects of the geohydrology of the Littlestown 7½-minute quadrangle in northwestern Carroll County, Md. It is intended primarily as an aid in land-use planning and decision making, assessing potential environmental problems, and locating ground-water supplies. Land use in the Littlestown quadrangle is mainly agricultural and woodland, but small communities and dispersed residential housing occupy part of the land.

The climate is typical of the humid Piedmont region of Maryland. Average annual precipitation is approximately 43 inches. Precipitation is distributed fairly evenly throughout the year, although it is somewhat greater in summer and less in fall and winter.

The Littlestown quadrangle is drained by tributaries of the Monocacy River, primarily Big Pipe Creek. Topography is mostly hilly, and is undulating in the extreme western part of the area. Maximum relief is approximately 470 feet.

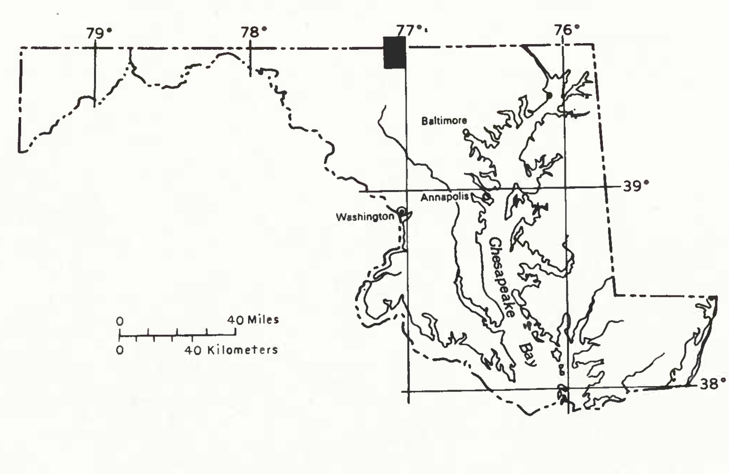


Figure 1.--Location of Littlestown Quadrangle.

HYDROLOGY

Precipitation recharges the local ground-water reservoirs, which consist of pore spaces in the weathered rock (saprolite) and fractures in the unweathered rock. Ground-water runoff from seeps and springs sustains the flow of streams during periods of no rain. The water table is the top of the zone of saturation in the rocks. It rises and falls in response to changes in ground-water storage resulting from imbalance between ground-water recharge and discharge. Rock that is in the saturated zone and can yield water to wells and springs is termed an aquifer. Some of the Piedmont crystalline rocks, such as marble, tend to be more productive aquifers than others, such as schist or phyllite. Well yield is related to some degree to topographic position (often, valley sites are more productive than others), nature and thickness of the weathered zone, and extent to which the rocks have been fractured.

GEOLOGY

The Littlestown quadrangle is underlain chiefly by metamorphosed sedimentary rocks of early Paleozoic age, but the westernmost part of the quadrangle is underlain by sedimentary rocks of Triassic age. The Triassic rocks are considerably jointed and faulted. The older rocks are folded, in addition.

The rocks are overlain chiefly by soil and weathered rock, which together are referred to here as overburden. In some places, as along steep slopes, the overburden is thin or absent. Well records show that above the Triassic rocks, its thickness averages 20-25 ft and may exceed 63 ft. Above the older (Paleozoic) rocks, the thickness of the overburden averages about 36 ft, and may exceed 195 ft at the maximum.

The reader is referred to Cleaves, Edwards, and Glaser (1968) for additional information on the geology. Recently, detailed geologic mapping on a scale of 1:24,000 was completed in Carroll County, by the Maryland Geological Survey.

MAPS INCLUDED IN ATLAS

Map 1. Slope of Land Surface, by Photo Science, Inc.

Map 2. Depth to Water Table, by John T. Hilleary and James M. Weigle.

Map 3. Availability of Ground Water, by James M. Weigle.

Map 4. Constraints on Installation of Septic Systems, by James M. Weigle.

Map 5. Locations of Wells and Springs, by John T. Hilleary and James M. Weigle.

LIMITATIONS OF MAPS

Interpretation of available data, and some degree of judgment were required in preparing the maps in this atlas. The information shown on the maps does not eliminate the need for tests and detailed evaluation at specific sites.

SLOPE OF LAND SURFACE

prepared by Photo Science, Inc.

EXPLANATION

Four slope categories are shown on this map. Terrain having the maximum slope (greater than 25 percent) currently (1980) exceeds the maximum land slope permitted for the installation of domestic sewage-disposal systems (septic tanks) by the Carroll County Health Department. Other terrain categories are useful in planning certain construction activities involving local roads and drains, and in planning airport locations.

This map was prepared using topographic contour negatives by a process developed by the U.S. Geological Survey, Topographic Division. The process uses a semiautomated photomechanical process, which translates the distance between adjacent contours into slope data. The slope zones on the map are unedited. Proximity of the same contour or absence of adjacent contours may produce false slope information at small hilltops and depressions, on cuts and fills, in saddles and drains, along shores of open water, and at the edges of the map.

SELECTED REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geological Survey.

Meyer, Gerald, 1958, The ground-water resources in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 1/ Bulletin 22, p. 1-228.

Nutter, L. J., 1974, Well yields in the bedrock aquifers of Maryland: Maryland Geological Survey Information Circular 16, 24 p.

Nutter, L. J., and Otton, E. G., 1969, Ground-water occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations 10, 56 p.

Otton, E. G., and others, 1979, Hydrogeologic atlas of Westminster quadrangle, Carroll County, Maryland: Maryland Geological Survey Atlas No. 9, 5 maps.

Stose, A. J., and Stose, G. W., 1944, Geology of the Hanover-York district, Pennsylvania: U.S. Geological Survey Professional Paper 204, 84 p.

______1946, Geology of Carroll and Frederick Counties, in The physical features of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 1/ p. 11-128.

University of Maryland, Maryland State Roads Commission, U.S. Bureau of Public Roads, 1963, Engineering soil map of Carroll County (1 sheet).

U.S. Department of Agriculture, Soil Conservation Service, 1969, Soil survey, Carroll County, Maryland: 92 pages, 55 photomaps, 1 index.

______1971, Soils and septic tanks: 12 p.

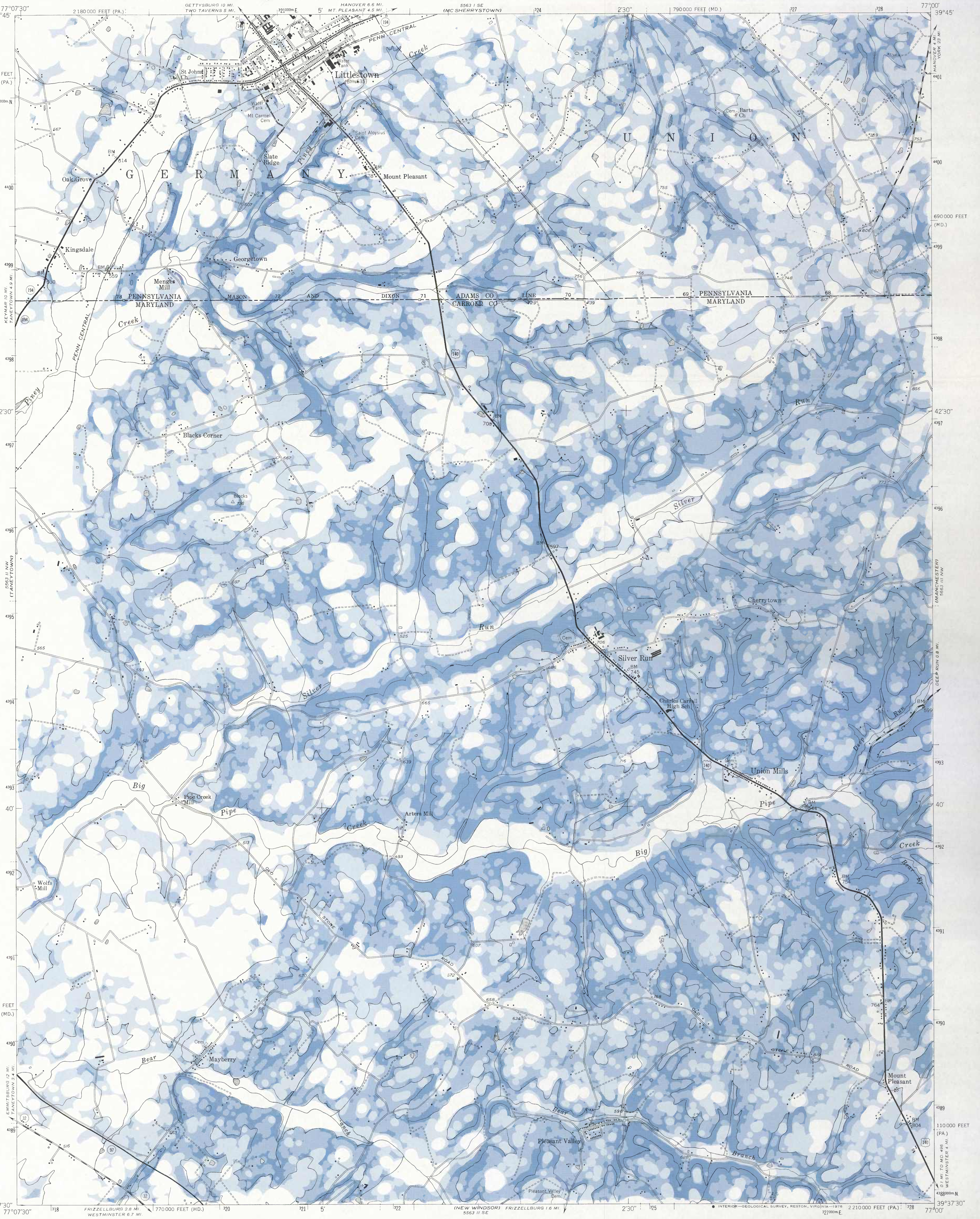
U.S. Public Health Service, 1967, rev., Manual of septic-tank practice: 92 p.

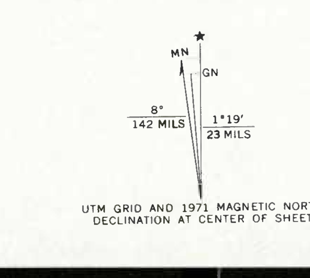
1/ The name of this agency was changed to Maryland Geological Survey in June 1964.

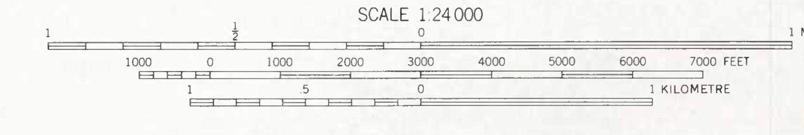
CONVERSION FACTORS

In this atlas, figures for measurements are given in inch-pound units. The following table contains the factors for converting these units to metric (System International or SI) units:

Inch-pound unit	Symbol	Multiply by	Metric unit	Symbol
inch	(in.)	25.40	millimeter	(mm)
foot	(ft)	0.3048	meter	(m)
mile	(mi)	1.609	kilometer	(km)
square mile	(mi^2)	2.590	square kilometer	(km^2)
U.S. gallon	(gal)	3.785	liter	(L)
U.S. gallon per minute	(gal/min)	0.06309	liter per second	(L/s)
U.S. gallon per minute per foot	[(gal/min)/ft]	0.2070	liter per second per meter	[(L/s)/m]

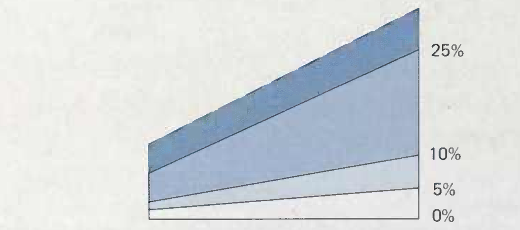






CONTOUR INTERVAL 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1981



MAP 2. DEPTH TO WATER TABLE

DEPTH TO WATER TABLE

By John T. Hilleary and James M. Weigle

EXPLANATION

This map shows the approximate depth to the water table (the top of the zone of saturation). Well and spring records in Meyer (1958) and considerable additional well data collected during this study were used in preparing the map. However, limits of areas where the water table is shallow (0 to 10 ft) were based largely on the perennial-stream network as shown on the topographic maps. Limits of areas where the water table is fairly deep (more than 35 ft) were based mainly on well records and topographic relations. In this region, water-table depths from 0 to 10 ft occur mostly in lowlands, and depths greater than 35 ft generally are restricted to hilltop areas.

Locally, and especially in the overburden, saturated zones may be perched above the main water table. Most of the perched zones are seasonal or even more short-lived. No attempt has been made to show them on this map. For more detailed information on local perching of ground water, see U.S. Department of Agriculture, Soil Conservation Service (1969).

The water table fluctuates with changes in ground-water storage, which are caused by relative changes in recharge and discharge. The fluctuations may be measured in days or less, or they may range up to years in duration. Seasonal fluctuations are cyclic and occur chiefly in response to increased ground-water losses due to greater evaporation and transpiration during the growing season. Typically, the water table is highest in late winter and early spring. Generally, it declines through late spring and summer, and through much of the fall. Seasonal water-table fluctuations tend to be greater under hilltops and smaller in valleys. Some effects of seasonal water-table decline are seasonal lowering of water levels in wells, and decreased flow of springs and "fair-weather" flow of streams. The reader is referred to Meyer (1958) for graphs of water-level fluctuations in representative observation wells in Carroll County, and to Otton (1979) for illustrations of statistical treatment of water-level fluctuations in several wells in Carroll and Baltimore Counties.

Because of water-table fluctuations the areas shown on this map are not static, but change seasonally and from year to year. The map shows generalized water-table conditions, and is intended for use on a reconnaissance basis only.

REFERENCES

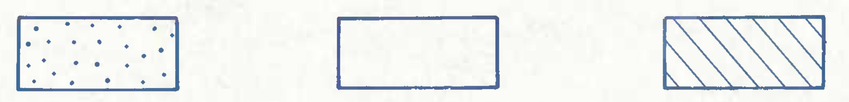
Meyer, Gerald, 1958, The ground-water resources in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources [1/] Bulletin 22, p. 1-228.

Otton, E. G., 1979, Hydrogeologic atlas of Westminster quadrangle, Carroll County, Maryland: Maryland Geological Survey Atlas No. 9, 5 maps.

U.S. Department of Agriculture, Soil Conservation Service, 1969, Soil survey, Carroll County, Maryland: 92 pages, 55 photomaps, 1 index.

1/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

APPROXIMATE DEPTH TO WATER IN FEET BELOW LAND SURFACE



1981

Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

AVAILABILITY OF GROUND WATER

By James M. Weigle

INTRODUCTION

Ground water in the area shown on this sheet occurs chiefly in joints, faults, and other fractures in metamorphic and sedimentary-rock aquifers, and in intergranular spaces in the saturated part of the overburden.

Availability of ground water increases with the number of interconnected fractures in the saturated zone (fig. 1). High yields and specific capacities 1/ sometimes result where wells penetrate fracture zones associated with faults (fig. 2).

In the western part of this map, the area shown as Geohydrologic Unit 5 is underlain by faulted and jointed sedimentary rocks, primarily sandstone, siltstone, and shale, and some conglomerate. The overburden there tends to be thinner than that overlying the metamorphic rocks. Folded, faulted, and jointed metamorphic rocks underlie the rest of the area. They are primarily phyllite, quartzite, and calcareous rocks. The overburden is generally thicker than that associated with the sedimentary rocks. The stratigraphic nomenclature follows the usage of the Maryland Geological Survey. The names, Littlestown Slaty Quartzite, Babylon Phyllite, and Blacks Corner Phyllite are new unpublished names used by the Maryland Geological Survey.

SELECTION OF UNITS

The Marburg Formation of former usage (Ijamsville Phyllite of Fisher, 1978) is phyllite, with lenses of quartzite and limestone. In spite of those lenses, the range in yield and specific capacity is generally conservative. The "Marburg Formation," including the quartzite and limestone, is placed in Geohydrologic Unit 3A.

The Babylon Phyllite and Blacks Corner Phyllite are very similar to one another in lithology and in water-bearing characteristics. They differ from the "Marburg Formation" in that they are more productive, and their range in yield and specific capacity is greater. The Babylon Phyllite and Blacks Corner Phyllite are placed in Geohydrologic Unit 3B.

Where it occurs on this map, the Littlestown Slaty Quartzite is uniform in lithology. Yield-test results are too few to justify graphing well yields or specific capacities; but they, also, indicate uniformity in water-bearing characteristics. The Littlestown Slaty Quartzite is placed in Geohydrologic Unit 3C.

Two lithologic features distinguish the New Oxford Formation as it occurs in the area on this map (limits coincide with those of Geohydrologic Unit 5):

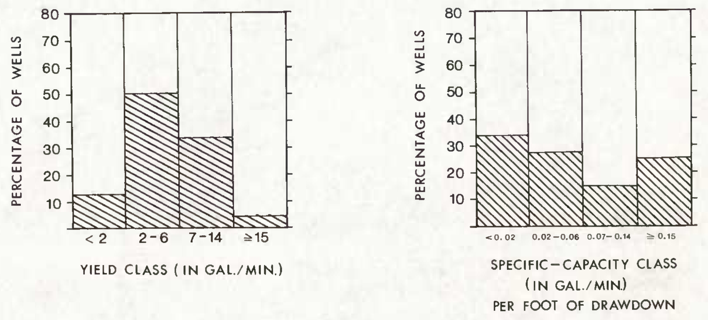
(1). Thick-bedded lenses of quartz-pebble conglomerate occur near the eastern limit of the formation and form ridges there. The matrix is medium to coarse quartz-feldspar sand.

(2). Considerable medium- to coarse-grained feldspathic sandstone occurs in the lower 2,000 ft of the formation.

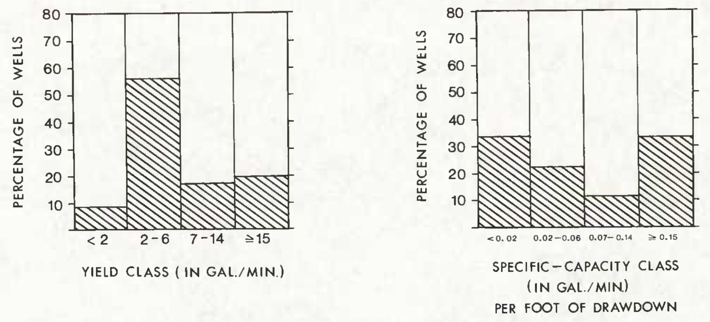
The rocks of the New Oxford Formation in this quadrangle have a higher average specific capacity and higher average potential well yield than do the rocks of the same formation in adjoining quadrangles to the west and southwest. Although joints and other fractures are probably the most common source of water for wells in the New Oxford Formation on this map, most of the higher specific capacities are associated with wells drilled in the conglomerate.

The coarse-grained sandstone in the lower part of the formation may also contribute to the relatively high average specific capacity. The rocks of the New Oxford Formation are included in Geohydrologic Unit 5.

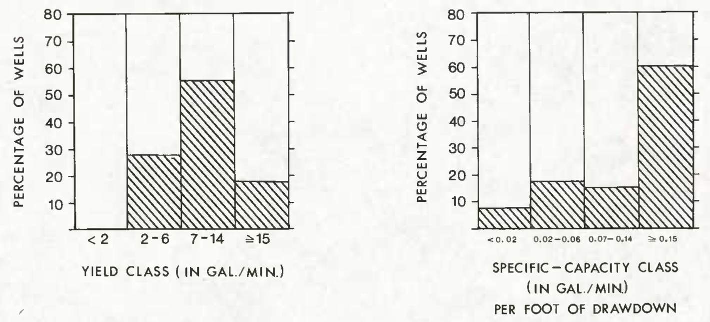
Units 1, 2, and 4 are omitted from the explanation because they do not occur in this quadrangle. They are present elsewhere in Carroll County or nearby counties.



Yields and specific capacities of wells in unit 3A.



Yields and specific capacities of wells in unit 3B.



Yields and specific capacities of wells in unit 5.

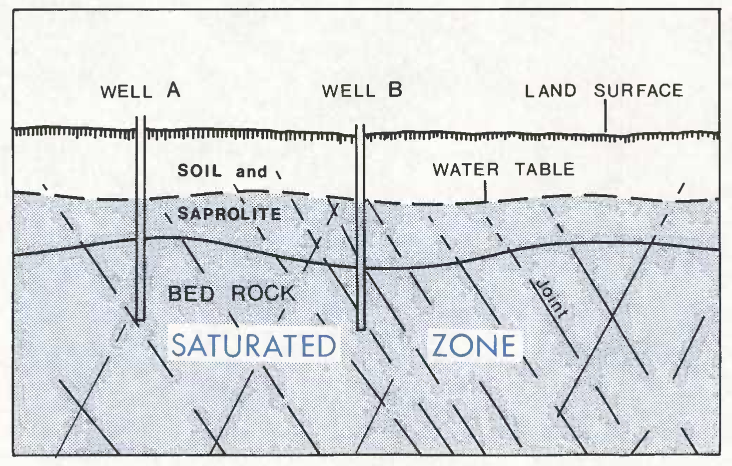


Figure 1.--Well b intersects more joints and has a larger yield than well A.

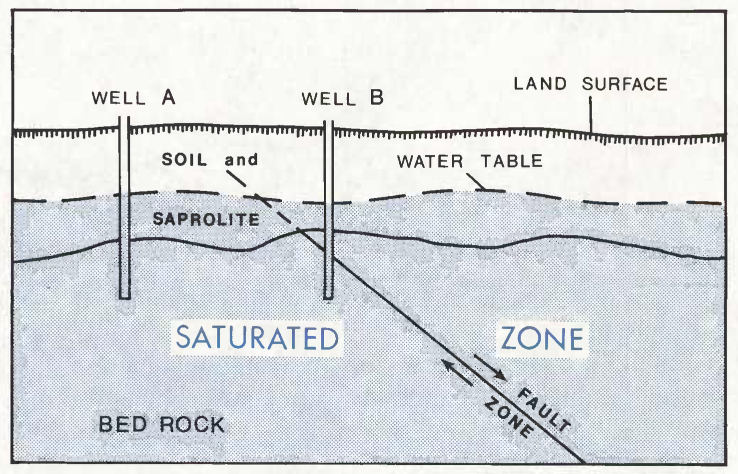


Figure 2.--Well B penetrates fault zone and yields more water than well A.

SELECTED REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geological Survey.

Fisher, G. W., 1978, Geologic map of the New Windsor quadrangle: U.S. Geological Survey Map I-1037.

Meyer, Gerald, 1958, The ground-water resources in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 2/ Bulletin 22, p. 1-228.

Nutter, L. J., 1974, Well yields in the bedrock aquifers of Maryland: Maryland Geological Survey Information Circular 16, 24 p.

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Stose, A. J., and Stose, G. W., 1946, Geology of Carroll and Frederick Counties, in The physical features of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources 3/ p. 11-128.

EXPLANATION

3A — GEOHYDROLOGIC UNIT 3A: This unit includes the Marburg Formation (Ijamsville Phyllite of Fisher, 1978). Well yields (48 wells) range from 1 to 20 gal/min, and the median yield is 3 gal/min. Specific capacities range from 0.00 to 0.8 (gal/min)/ft, and the median is 0.04 (gal/min)ft.

3B — GEOHYDROLOGIC UNIT 3B: This unit includes the Babylon Phyllite and the Blacks Corner Phyllite. Well yields (36 wells) range from 1/2 to 190 gal/min, and the median yield is 5 gal/min. Specific capacities range from 0.00 to 8.6 (gal/min)/ft, and the median is 0.05 (gal/min)/ft.

3C — GEOHYDROLOGIC UNIT 3C: This unit includes the Littlestown Slaty Quartzite. Yields 3/ from all tests 1 hour or more in length (7 wells) range from 4 to 12 gal/min, and the median yield is 9 gal/min; specific capacities range from 0.06 to 0.5 (gal/min)/ft, and the median is 0.19 (gal/min)/ft.

5 — GEOHYDROLOGIC UNIT 5: This unit includes the New Oxford Formation, with its quartz-pebble conglomerate member. Well yields (40 wells) range from 2 to 100 gal/min, and the median yield is 10 gal/min. Specific capacities range from 0.017 to 3.0 (gal/min)/ft, and the median is 0.18 (gal/min)/ft.

1/ Specific capacity of a well is the yield per foot of drawdown of the water level in the well, and is commonly expressed in gallons per minute per foot of drawdown. For many domestic wells, the period of measurement ranges from 2 to 6 hours.

2/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

3/ Well yields and specific capacities are based on yield tests by the well driller. The use of yield information in this atlas is limited to that obtained from tests at least 2 hours long, unless specified otherwise.

Maryland Geological Survey

MAP 3. AVAILABILITY OF GROUND WATER

Quadrangle Atlas No. 14

1981

Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

Maryland Geological Survey

MAP 4. CONSTRAINTS ON INSTALLATION OF SEPTIC SYSTEMS

Quadrangle Atlas No. 14

CONSTRAINTS ON INSTALLATION OF SEPTIC SYSTEM

By James M. Weigle

SELECTION OF UNITS

The areas in the three units shown on this map differ widely in suitability for locating domestic liquid-waste disposal systems because of differences in land slope, depth to the water table, and thinness and differences in infiltration characteristics of the overburden.

The following shows the range in hydrogeologic limitations or constraints, for domestic septic systems in the various units.

MAXIMUM CONSTRAINTS	MODERATE TO VARIABLE CONSTRAINTS	MINIMUM CONSTRAINTS
I	II	III

FACTORS CONSIDERED, AND THEIR SOURCE OF EVALUATION

1. Steep slopes are considered to be a major contributing cause of failure of underground sewage-disposal systems (U.S. Public Health Service, 1967, p. 18; and U.S. Department of Agriculture, Soil Conservation Service, 1971, p. 8). Maryland Department of Health regulations (July 1964, Section 1, definitions, part 1.9) do not permit, as of 1980, the installation of underground domestic sewage-disposal systems where the slope of the land surface exceeds 25 percent. Land slopes were obtained from a slope map prepared by Photo Science, Inc. (Map 1).

2. Shallow depth to the water table is a major limiting factor in considering construction of a liquid-waste disposal system. In areas where the depth to the water table is less than 10 ft, the risk of failure of such a system is high. In addition, the chances of polluting the ground-water supply are greater where the water table is shallow than where it is fairly deep. The 10-ft minimum depth was determined in the following manner: (a) The recommended depth to the bottom of the tile field is at least 3 ft below the land surface (U.S. Department of Agriculture, Soil Conservation Service, 1971, p. 3); (b) a minimum depth of 4 ft between the base of the tile field (absorption trench) and the underlying water table is recommended (U.S. Public Health Service, 1967, p. 11); and (c) a 3-ft additional depth is suggested to allow for seasonal variations in position of the water table, which commonly fluctuates through a 3-ft range in the Piedmont valleys. The extent of the areas having a shallow water table was taken from map 2.

3. Where bedrock crops out or occurs near land surface, construction of underground disposal systems is not feasible. Those areas generally occur where land-surface slopes are steep, and are included in unit I.

4. Infiltration rates also are a limiting factor in considering construction of liquid-waste disposal systems. Overburden having low permeability may not accept the effluent of a normal household. Where the permeability is high, the effluent may be inadequately renovated. Infiltration rates were determined primarily on the basis of data collected by Carroll County sanitarians during percolation tests conducted according to standardized procedures established by the Maryland Department of Health [1/].

5. Floods can cause dispersal of sewage and possible physical damage to disposal systems. Most valleys in the Littlestown quadrangle are subject to periodic flooding. In this quadrangle, the flood-prone areas lie entirely within the areas of shallow water table (map 2) and are therefore included in unit I on map 4.

SELECTED REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic map of Maryland: Maryland Geological Survey.

Fisher, G. W., 1978, Geologic map of the New Windsor quadrangle: U.S. Geological Survey Map I-1037.

Meyer, Gerald, 1958, The ground-water resources in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources [2/] Bulletin 22, p. 1-228.

Otton, E. G., and others, 1979, Hydrogeologic atlas of Westminster quadrangle, Carroll County, Maryland: Maryland Geological Survey Atlas No. 9, 5 maps.

University of Maryland, Maryland State Roads Commission, U.S. Bureau of Public Roads, 1963, Engineering soil map of Carroll County (1 sheet).

U.S. Department of Agriculture, Soil Conservation Service, 1969, Soil survey, Carroll County, Maryland: 92 pages, 55 photomaps, 1 index.

_______1971, Soils and septic tanks: 12 p.

U.S. Public Health Service, 1967 rev., Manual of septic-tank practice: 92 p.

1/ The percolation test conducted in Carroll County (1979) is performed as follows: A 2- to 3-ft-wide pit is dug to the depth to be tested, and a 1-ft-square hole is hand-dug 1-ft deep in the floor of the pit. The 1-ft hole is filled with water, and the time required for the water level to drop the second inch of a 2-inch decline is measured. For the test to be rated "passing", the time required for the water-level to drop the second inch must be between 2 and 30 minutes.

2/ The name of this agency was changed to the Maryland Geological Survey in June 1964.

MAP UNITS

I — UNIT I includes areas where the depth to the main water table ranges from 0 to 10 ft (map 2) and areas where the land slope exceeds 25 percent (map 1). This unit includes valley areas subject to periodic flooding and most of the areas where the overburden is thin or absent.

Results of 17 percolation tests in unit I show a very low incidence of failure (less than 4 percent). The percolation rate ranges from 1 to 26 min/in., and averages 7 min/in. The average depth of the test pits was 7.0 ft. The test results show that permeability, in unit I, is not a limiting factor.

II — UNIT II includes areas underlain by crystalline rocks, primarily phyllite, but including some quartzite and limestone. These rocks belong in the Marburg Formation of former usage (Ijamsville Phyllite of Fisher, 1978), Babylon Phyllite, Blacks Corner Phyllite, and Littlestown Slaty Quartzite. Overburden thickness averages 36 ft, and ranges from 3 to 195 ft. Land surface is a hilly to rolling upland, well dissected by many steep-sided valleys. Depth to the water table is greater than 10 ft.

Percolation-test data for unit II show a moderate to fairly high (25 percent) incidence of failure, and the average percolation rate is slower than 11 min/in. Failures were due to excessively slow and excessively fast percolation.

III — UNIT III includes areas underlain by rocks of the New Oxford Formation, consisting of reddish-brown shale, siltstone, sandstone, and some conglomerate. Saprolite thickness averages 22 ft, and ranges from 3 to 63 ft. Land surface is undulating to rolling. Depth to the water table is greater than 10 ft.

Percolation-test data for unit III suggest an average percolation rate somewhat slower than 13 min/in., and a low incidence of failure.

SCALE 1:24 000

QUADRANGLE LOCATION

1981

Prepared in cooperation with the
United States Geological Survey
and the
Commissioners of Carroll County

MAP 5. LOCATIONS OF WELLS AND SPRINGS

LOCATION OF WELLS AND SPRINGS

By John T. Hilleary and James M. Weigle

EXPLANATION

Information for wells and springs shown on this map is given by Meyer (1958), or is on file with the U.S. Geological Survey, Towson, Md., and the Maryland Geological Survey, Baltimore, Md. Logs and well-construction records are available for most wells shown. In addition, a report of basic ground-water data available for Carroll County is being prepared.

The wells and springs are numbered according to a coordinate system by which each Maryland county is divided into 5-minute quadrangles bounded by lines of latitude and longitude. The first letter of the well number identifies a 5-minute section of latitude; the second letter identifies a 5-minute section of longitude. The pairs of letters are followed by numbers assigned serially to wells. The letter-number term designates the well with respect to the 5-minute quadrangle, and is preceded by an abbreviation of the county name. Thus, well CL-AC 4 is the fourth well inventoried in 5-minute quadrangle AC in Carroll County. In reports describing wells in only one county, the county prefix letters frequently are omitted from the well-designation term. The numbering system currently in use (1980) differs slightly from that used in earlier published reports, such as that by Meyer (1958). In the 1958 report, well CL-AC 4 was designated as Car-Ac 4. The use of lower-case letters in well designation was discontinued because of a changeover in 1970 to a computer system for storing and retrieving well information.

10

WELL AND NUMBER

4

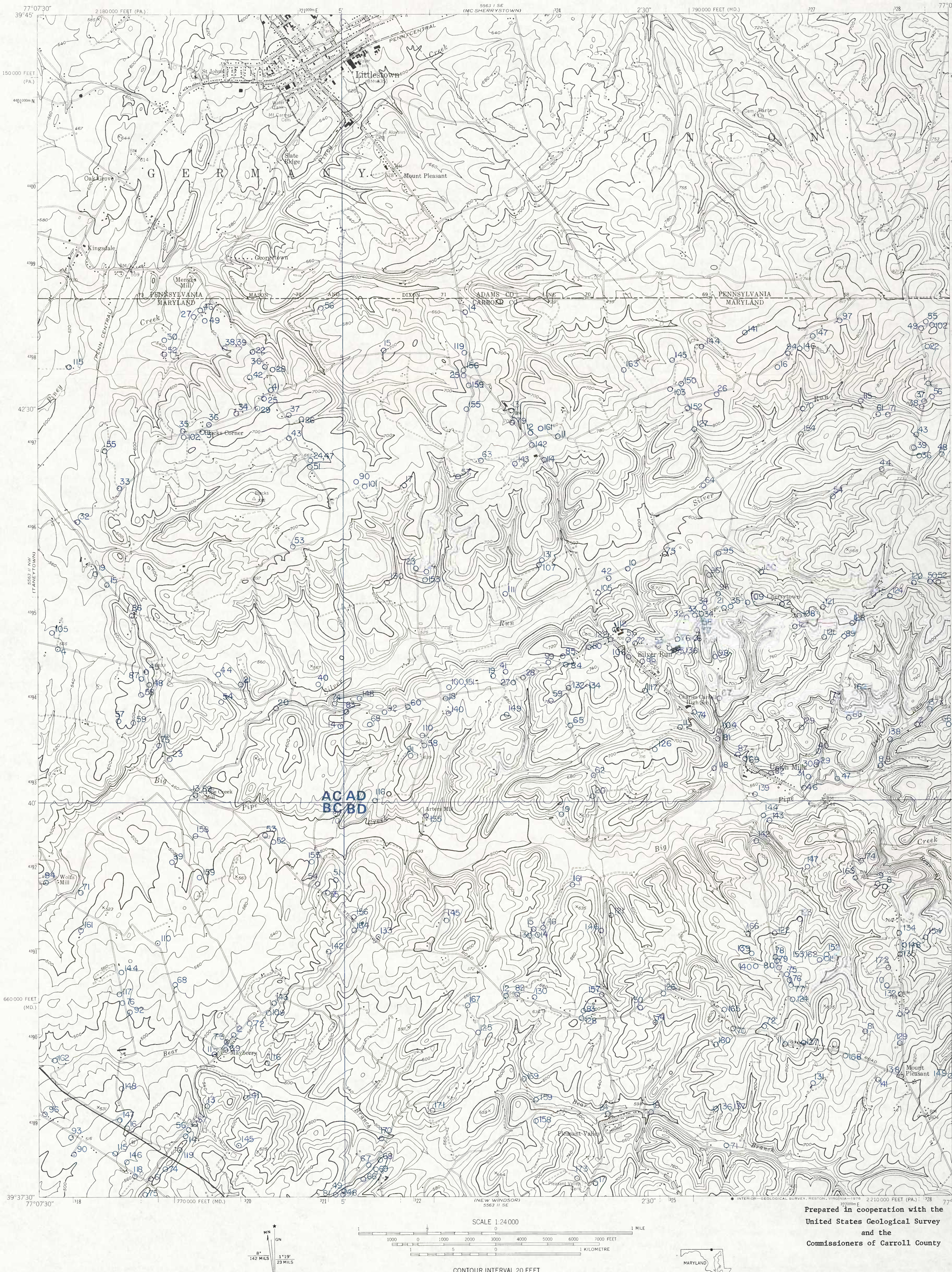
SPRING AND NUMBER

SELECTED REFERENCES

Cleaves, E. T., Edwards, Jonathan, Jr., and Glaser, J. D. (compilers and editors), 1968, Geologic Map of Maryland: Maryland Geological Survey, scale 1:250,000.

Meyer, Gerald, 1958, The ground-water resources in The water resources of Carroll and Frederick Counties: Maryland Department of Geology, Mines and Water Resources [1] Bulletin 22, p. 1-228.

1/ The name of this agency was changed to the Maryland Geological Survey in June 1964.



Prepared in cooperation with the United States Geological Survey and the Commissioners of Carroll County

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1981